OrientatUA: Mobile Application to guide visual disabled people at the University of Alicante

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Abstract

This paper shows an iOS application to guide visual disabled people in the campus of the University of Alicante by voice indications. The user interface is adapted to visual disabled people, using a bigger visual typography and a bigger area for the tactile buttons. Moreover, the application provides voice indications when users touch any of the elements in the interface, telling them where they are and how they can reach destination.

Keywords

Mobile Application; Visual Disabled People; Voice Messages; iOS; iPhone

Introduction

This paper shows an application to guide visual disabled people at the University of Alicante. This application has been developed for mobile devices, specifically for iOS (Apple operating system for mobile devices). These devices are categorized as Smartphone, which is an evolution of mobile devices with many functionalities, like camera, video recorder, Internet connection, GPS navigation, multi-touch screens, etc (*Teng and Helps, 2010*), (*LeMoyne et al, 2010*).

General applications oriented to visual disabled people are available. *Roig, (2012*) has developed the "OnTheBus" application for Android operating system, by which blind people is guided after indicating the desired address through their voice or by touching character by character on the screen. Sergio Macetti (*2012*) worked out in the "ZebraLocalicer" application, which devised crosswalks in cities for blind people. In relation to voice guides, "WalkyTalky" (*Google Inc, 2012*) can be designed. This application indicates by a voice message the name of the street where you are walking. Google also has another application called "Intersection Explorer" (*Google Inc., 2013*) which says the directions and street names that you are touching in the map view. Moreover, "Kapten for Smartphone" (*KapSys, 213*) is available, a GPS navigation application with a fully vocal and accessible user interface.

One of the most remarkable functionalities is the capacity to locate our own position in a map, like Google Maps (*Google Inc, 2011*) or iOS Maps (*Apple, 2012*), making easy to have access to any concrete address. The problem arises when there have no specific address names to locate the different buildings, as in the case of universities campus (e.g. the Campus of University of Alicante). Moreover, in these situations, the greater number of developed phone applications shows the information in visual format with a map route or a list of indications, which is no very convenient for people with some visual disabilities.

In order to overcome this problem, an application for iOS has been developed using some features of Smartphones (such as the GPS, and compass), which allows finding any building at the Campus of the University of Alicante. In addition, our application helps us to reach any destination inside the Campus. It also provides information about the buildings that are close to our position. The visual information provided by the interface is also complemented with voice messages with indications about the current place or the place where the user want to move. These indications are especially helpful for people who have some visually disabilities. Currently, there is no similar application in Spanish universities.

The organization of the paper is as follows: section 2 deals with the methodology and procedure carried out. In section 3 the development of the map view controller is illustrated in details. Finally, Sections 4 and 5 show the experimental results of the algorithm and the main conclusions.

Development and Methodology

Resources

For the new application, a variety of tools provided by Apple to develop applications in iOS has been used. Xcode (*Apple, 2013*) has been employed, which provides access to the necessary frameworks and all the information about different functionalities of the development environment, as well as different templates for a variety of applications.

The Interface Builder tool has been utilized as well to get access directly from Xcode when a NIB archive is selected, which has a user interface for the application. With this tool, the user interface can be designed in a graphic way, making easy great part of the task. The another tool used is the iOS Simulator, to test the progress during the development of the application.

In addition, the universities license is in use provided by Apple, known as iOS Developer University Program (Licensed to the University of Alicante).

In the first stage of the development, iUA application (*University of Alicante, 2012*) is strongly dependent to create our database. This is another application previously developed at the University of Alicante with information on studies, college grants and access to the different facilities, and then different audio files are incorporated, which conform to the audio voice system of the application. These voice recorders are categorized according to distance, address, name of the building and category, including a variety of warnings and helpful phrases.

User Interface of OrientatUA

The application provides two main functionalities: 1) A visual and audio guide to go to any particular building along the Campus, and on the other hand, 2) an audio database with a brief description of the different buildings, which would be used to provide information about the buildings located around the users. Thus, the interface presents two different tabs, for each functionality, respectively.

In Fig.1 the splash screen of OrientatUA can be observed. After loading the main screen, in the first tab we can find a list of categories (Fig. 2.a and Fig. 2.b), where the buildings are located in the Campus. After the selection of the building, the application will provide us a map and different voice messages with indications to get there (Fig. 2.c).

In the second tab, a map can be seen with our current position together with a signposting of the buildings around us with information about its name (Fig. 2.d).

In both cases, the voice indications could be obtained with a touch in the screen. We have added also a view with information accessible on top of the first tab, which provides a window with the application usage information, while a voice message plays this information.

FIG. 1 ORIENTATUA FOR IPHONE: STARTING SPLASH SCREEN

FIG. 2 SCREENSHOTS OF THE APPLICATION (a) CATEGORIES SELECTION (TEACHING, GARDENS, SPORT, ETC.) (b) BUILDING SELECTION. (c) MAP WITH DIRECTIONS TO GET A DESTINATION. (d) MAP WITH INFORMATION AROUND THE USER

The Map View Controller

The main component of the application is the map view controller (*Stelte and Hochstatter, 2009*) since it is in charge to control, at any time, the position of the user and the direction towards which the phone device is pointing, to generate the proper indication in each situation: “go straight”, “turn right”, “turn left”, “turn around”.

Our controller also checks the position where we are, in order to adapt the view of the map to the characteristics of each function, showing only the position of the building where we want to go, or all the other buildings around us. This controller changes the message with vocal indications according to each situation whenever the user touches on the map view.

In the first place, our application provides the route by triangulation of positions (*Renka, 1997*). An auxiliary intersection point is necessary between the position of the user (latitude_1, longitude_1) and the position of the destination (latitude_2, longitude_2), as shown in Fig. 3.

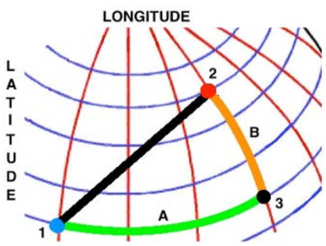


FIG. 3 TRIANGULATION DIAGRAM: (*1*) USER POSITION; (*2*) DESTINATION POINT; (*3*) AUXILIARY POINT; (*A*) DISTANCE BETWEEN USER POSITION AND AUXILIARY POINT; (*B*) DISTANCE BETWEEN AUXILIARY POINT AND DESTINATION POINT

A distance is calculated from the user position to the auxiliary point (distance_A), associated with a relative position in function of the longitude of the destination (longitude_2). In this way, our application indicates if the buildings are in the “East” or “West” from our position (*Wu et al, 2007*).

Next, we also get the distance from the auxiliary point to the building that we are looking for (distance_B), which is associated with a position in function of the latitude of the destination (latitude_2), providing the position of the building relative to “North” or “South” according to the situation. To determine these relative positions, It should be kept in mind that the higher latitude involves that this point is further north of the “Ecuator” and if the point has higher longitude, this is located further east of the central meridian. By means of two conditional sentences, the latitudes and longitudes of the user position and destination point have been compared:

$$user\_position\_lat = \begin{cases} @North, & if \quad Latitude2 > Latitude1 \\ @South, & otherwise \end{cases} \quad (1)$$

$$user\_position\_lon = \begin{cases} @East, & if \quad Longitude2 > Longitude1 \\ @West, & otherwise \end{cases} \quad (2)$$

These relative positions are used to generate different kinds of audio guides like “go straight”, “turn right”, “turn left” or “go back” in accordance to the direction where the Smartphone is pointing.

The possible directions are limited: north, south, east and west, to simplify the instructions used by the application (*Merino, 2013*). This is done by allocating a certain range of angles provided by the device compass for every possible direction, as seen below:

$$location(heading) = \begin{cases} @North & if \begin{pmatrix} previousHead < 45.0 & and \\ previousHead \geq 315 & \end{pmatrix} \\ @East & if \begin{pmatrix} previousHead \geq 45.0 & and \\ previousHead < 135 & \end{pmatrix} \\ @South & if \begin{pmatrix} previousHead \geq 135 & and \\ previousHead < 225 & \end{pmatrix} \\ @West & if \begin{pmatrix} previousHead \geq 225 & and \\ previousHead < 315 & \end{pmatrix} \end{cases} \quad (3)$$

Once the application knows where the user is pointing, the application generates the appropriate message through a set of conditional blocks (Fig. 4).

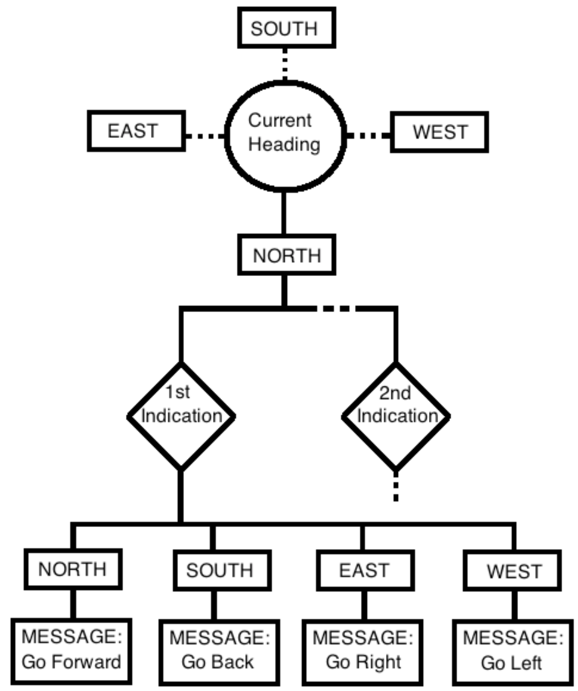


FIG. 4 CONDITIONAL BLOCKS FOR GENERATING VOICE MESSAGES IN “ORIENTATUA”. IF THE USER IS TAKING A WRONG ROUTE, THE APPLICATION CORRECTS HIM. THE USER CAN CHECK IF HE IS ON THE RIGHT TRACK AT ANY TIME JUST BY TOUCHING ON THE SCREEN

The message emitted by the application has two indications for the purpose of guiding to the user: go forward/back and turn left/right. The functions above are evaluated for these two indications, and for each possible direction in which the user can point with the device.

In the second tab of the application, the controller checks the buildings that are close to the user's position and provides a message with the name of the buildings.

Results

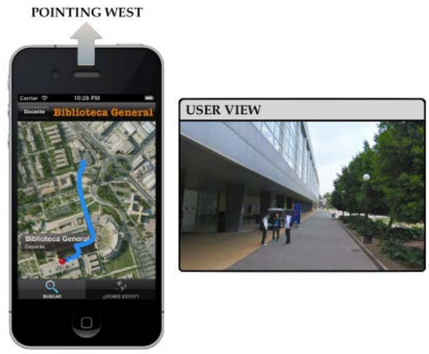
In order to check whether our application "OrientatUA" works properly, it has been installed in several versions of IOS 5, 6 (iPhone 4, 4s, 5) and tested by different users at the University of Alicante.

In Fig. 5 it can be observed that four steps have been performed by a user to locate a building. Table 1 shows the data used by our application to generate voice messages along the route. In this example, the route involves going from the Polytechnic School building to the Central Library of the University of Alicante.

(a) Voice message, Position# 1: "The building you are looking for is about four hundred meters to the forward direction and about two hundred meters to the right"

(b) Voice message, Position# 2: "The building you are looking for is about two hundred meters to the right and one hundred and fifty meters to the forward"

(c) Voice message, position #3: "The building you are looking for is about hundred and fifty meters to the left and one hundred meters to the forward direction"



(d) Voice message, Position#4:"The building you are looking for is on your left."

FIG. 5 EXAMPLE OF THE APPLICATION: STEPS TO LOCATE A BUILDING AT THE UNIVERSITY OF ALICANTE. BELOW THE IMAGES, IN CURSIVE LETTERS, THE RESPECTIVE VOICE MESSAGES ARE ALSO SHOWN

TABLE 1 DATA FOR GENERATING VOICE MESSAGES IN "ORIENTATUA"

Positions	**Latit.**	**Longit.**	**Pos_Lat**	**Pos_Long**	**Dist_A – Dist B (m)**
Building	38.3832	-0.5121	--------	--------	--------
Position #1	38.3865	-0.5113	SOUTH	WEST	200 – 400
Position #2	38.3846	-0.5111	SOUTH	WEST	200 – 150
Position #3	38.3840	-0.5116	SOUTH	WEST	100 – 150
Position #4	38.3836	-0.5120	SOUTH	WEST	50 - 20

The application is available for free download since July 2012. With respect to the kind of current users, the application has been mainly downloaded by students (32%) and teaching and administrative staff (41%). The other users are not members of the University of Alicante. Among all the users who use the application, 15% have some kind of visual disability.

Conclusions

In this paper, an application has been designed to guide visual disabled people at the University of

Alicante. The application works properly and provides the right indications in every moment for all the building of the Campus, with an accuracy of 100%. The application can be easily applied to new facilities by just updating the database with the new information about the position of buildings. Moreover, the application can be also used in other campus or even in other places with similar characteristics, by changing only the database. Currently, the application "OrientaUA" for Android OS devices has been implemented.

For future developments, this application would be adapted to the iPad device, and including the voice messages information about the estimated time to reach any destination, based on the speed at which the user walks. Moreover, a new tab with language selection will be also included.

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